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| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/616,056  | 07/09/2003  | Gab-Jin Nam          | 5649-1073           | 9528             |
| 20792   | 7590        | 03/28/2005           | EXAMINER            |                  |
| MYERS BIGEL SIBLEY & SAJOVEC<br>PO BOX 37428<br>RALEIGH, NC 27627 |             |                      | BLUM, DAVID S       |                  |
|   |             |                      | ART UNIT            | PAPER NUMBER     |
|   |             |                      | 2813                |                  |

DATE MAILED: 03/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                                      |                                   |  |
|------------------------------|--------------------------------------|-----------------------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/616,056 | <b>Applicant(s)</b><br>NAM ET AL. |  |
|                              | <b>Examiner</b><br>David S. Blum     | <b>Art Unit</b><br>2813           |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 07 January 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-14, 63, 78 and 95-136 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-13 is/are allowed.
- 6) ☒ Claim(s) 14, 63, 78 and 98-136 is/are rejected.
- 7) ☒ Claim(s) 95-97 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>9/16/04</u> . | 6) <input type="checkbox"/> Other: _____  |

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This action is in response to the election filed 1/7/05.

## **DETAILED ACTION**

### ***Election/Restrictions***

1. Applicant's election without traverse of claims 1-14, 63, 78, and 95-136 in the paper filed 1/7/05 is acknowledged.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 78 cites the limitation "applying a thermal process to the first and second tantalum titanium oxide films" in the previous steps. There is insufficient antecedent basis for this limitation in the claim as the claim recites forming a tantalum titanium oxide film" and a second titanium oxide film".

4. Claims 124 and 125 cites the limitation "of the second tantalum titanium oxide film" in claim 78. There is insufficient antecedent basis for this limitation in the claims.

### ***Claim Objections***

5. Claim 110 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is

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required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 63 limits step b to adjusting the density of titanium to be 0.1 to 15 percent. Claim 110 repeats this limitation.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 14 and 98-101, and 63 and 110-118, 120, and 123 are rejected under 35 U.S.C. 102(e) as being anticipated by Shih (US 006640403).

Shih teaches all of the positive steps of claims 14 and 98-101, and 63 and 110-118, 120, and 123 as follows.

Regarding claim 14, Shih forms a first electrode (conductive layer 110), a suppressing layer (112) on the first electrode, and a dielectric layer (114) on the reaction layer so that the reaction suppressing layer is between the first electrode and the dielectric layer (figure 2) and the dielectric layer includes titanium (column 2 line 40).

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Regarding claim 98, the reaction suppressing layer comprises silicon nitride (column 2 line 39).

Regarding claim 99, the dielectric layer includes tantalum (column 2 line 40).

Regarding claim 100, the dielectric layer comprises tantalum titanium oxide (column 2 line 40).

Regarding claim 101, the first electrode is between the substrate and the reaction suppressing layer (figure 2).

Regarding claim 63, Shih forms a lower electrode (conductive layer 110) on a semiconductor substrate, a dielectric layer (114) of an oxide film including titanium and tantalum (column 2 line 20) on an upper surface of the electrode, forming an upper electrode (116) on the surface of the dielectric layer, where the density of titanium in the dielectric layer depends upon the thickness of the dielectric layer (as there are no limitations as to how the titanium density depends upon the thickness, Shih reads on this), and where the density of titanium is adjusted to be 0.1 to 15 percent (column 2 line 41).

Regarding claim 110, the density of titanium is adjusted to be 0.1 to 15 percent (column 2 line 41).

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Regarding claim 111, a reaction suppressing layer (112) is formed between the lower electrode and the dielectric layer.

Regarding claim 112, the reaction suppressing layer is silicon nitride (column 2 line 39).

Regarding claim 113, the reaction suppressing layer is applied by rapid thermal nitridation (column 2 line 47).

Regarding claim 114, the reaction suppressing layer is formed by chemical vapor deposition (column 2 line 46).

Regarding claim 115, a titanium precursor, a tantalum precursor, and oxygen gas are supplied separately to a reactor and reacted to each other (column 2 lines 52-65).

Regarding claim 116, the tantalum precursor is a metal alkoxide (alkoxy, column 2 line 58).

Regarding claim 117, the titanium precursor is  $\text{Ti}(\text{C}_3\text{H}_7\text{O})_2$  equivalent to a compound such as  $\text{Ti}(\text{OCH}(\text{CH}_3)_2)_4$ . (column 2 lines 59-63).

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Regarding claim 118, the two precursors are mixed outside the reactor (column 2 lines 62-64, mixing box) and are sent to the reactor (showerheads 50 to place gases into reactor).

Regarding claim 120, Shih teaches controlling the density of the titanium, and also teaches controlling the temperature and gas flow rate (vaporizing temperatures and decomposition temperatures are also listed) suggesting the flow rates and temperatures affect the product composition, thus controlling the density of the titanium.

Regarding claim 123, a thermal process under an oxygen atmosphere is applied after step b and before step c (column 3 lines 51-53).

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 119 and 78 and 121-136 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shih (US006640403) in view of Park (US2004/0018307).

Shih teaches all of the positive steps of claim 119 as recited above in regard to claim 118 above except for the specific precursor recited in claim 119.

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Regarding claim 119, Shih teaches precursors that are listed in the instant specification, but not the specific ones of claim 119, Park (paragraph 0025) lists several precursors that are nearly identical to that of the instant claim. The Markush groups are not inclusive of all possible formulas suggesting that other formulations may be used. Further, the instant specification does not teach any criticality among the precursors used.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Shih by using precursors as taught by Park. One skilled in the requisite art would use known precursors to produce the desired film rather than to spend research time and dollars to derive a process that is available to the public.

Shih teaches all of the positive steps of claims 78 and 124-136 except for forming multiple tantalum titanium layers.

Regarding claim 78, Shih forms a lower electrode (conductive layer 110), a reaction suppressing layer (112) on the lower electrode, a tantalum titanium oxide layer (114) on the upper layer of the reaction suppressing layer, applies a thermal process on the



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tantalum titanium layer (column 3 line 51-53), and forms an upper electrode (116) on the tantalum titanium layer. Park teaches that the process (same as Shih) forms consecutive tantalum titanium layers. Thus Park not only suggests the formation of multiple tantalum titanium layers, but also teaches that this would be inherent to the process of Shih.

Regarding claim 121, the dielectric layer is formed at 400 degrees C (column 3 line 59) and at a pressure of 1 torr (figure 4), 1 torr=1 mmHg at ) degrees C. (claim reads 100-760mTorr at 100-700 degrees C. It is believed the "m" should be "mm").

These ranges are considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* (105 USPQ233), the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*In re Aller* 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of regarding concentrations

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(density of constituent), temperature and pressure using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the film desired to the parameters desired.

Regarding claim 122, the tantalum and titanium precursor are provided at a rate of 5-200mg/min (figure 4 in gas flow rate (sccm) rather than (mg/min).

Regarding claim 124, the density of the second tantalum titanium film is 5-15 percent (column 2 line 41). As the instant specification teaches up to 20 percent, this is a matter of optimization as recited above.

Regarding claim 125, the density of the second tantalum titanium film is 5-15 percent (column 2 line 41).

Regarding claim the reaction suppressing film is silicon nitride (column 2 line 39).

Regarding claim 127, the reaction suppressing layer is applied by rapid thermal nitridation (column 2 line 47).

Regarding claim 128, the reaction suppressing layer is formed by chemical vapor deposition (column 2 line 46).

Regarding claim 129, a titanium precursor, a tantalum precursor, and oxygen gas are supplied separately to a reactor and reacted to each other (column 2 lines 52-65).

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Regarding claim 130, the tantalum precursor is a metal alkoxide (alkoxy, column 2 line 58).

Regarding claim 131, the titanium precursor is  $\text{Ti}(\text{C}_3\text{H}_7\text{O})_2$  equivalent to a compound such as  $\text{Ti}(\text{OCH}(\text{CH}_3)_2)_4$ . (column 2 lines 59-63).

Regarding claim 132, the two precursors are mixed outside the reactor (column 2 lines 62-64, mixing box) and are sent to the reactor (showerheads 50 to place gases into reactor).

Regarding claim 133, Shih teaches precursors that are listed in the instant specification, but not the specific ones of claim 119, Park (paragraph 0025) lists several precursors that are nearly identical to that of the instant claim. The Markush groups are not inclusive of all possible formulas suggesting that other formulations may be used. Further, the instant specification does not teach any criticality among the precursors used.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

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Regarding claim 134, Shih teaches controlling the density of the titanium, and also teaches controlling the temperature and gas flow rate (vaporizing temperatures and decomposition temperatures are also listed) suggesting the flow rates and temperatures affect the product composition, thus controlling the density of the titanium.

Regarding claim 135, the dielectric layer is formed at 400 degrees C (column 3 line 59) and at a pressure of 1 torr (figure 4), 1 torr=1 mmHg at 0 degrees C. (claim reads 100-760mTorr at 100-700 degrees C. It is believed the "m" should be "mm").

Regarding claim 136, the tantalum and titanium precursor are provided at a rate of 5-200mg/min (figure 4 in gas flow rate (sccm) rather than (mg/min).

It would be obvious to one skilled in the requisite art at the time of the invention would modify Shih to form multiple layers of tantalum titanium oxide as taught by Park to be inherent to the process

***Allowable Subject Matter***

10. Claims 1-13 are allowed.

11. The following is an examiner's statement of reasons for allowance:

Claim 1 limits the formation of an electronic device to forming two layers of tantalum titanium oxide on a reaction suppressing layer where the two layers have

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different densities of titanium (COMBO) Neither Shih (US 6640403) nor Park )US0018307) teach or suggest altering the titanium content (density) within a layer or among consecutive layers.

Claims 2-13 are allowed as being properly dependent upon allowed claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

12. Claims 95-97 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

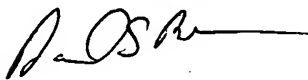
Claim 95 limits the formation of an electronic device to forming two layers of tantalum titanium oxide on a reaction suppressing layer where the two layers have different densities of titanium (COMBO) Neither Shih (US 6640403) nor Park )US0018307) teach or suggest altering the titanium content (density) within a layer or among consecutive layers.

Claims 96-97 are dependent upon claim 95.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



David S. Blum

March 21, 2005